PI MU EPSILON JOURNAL

THE OFFICIAL PUBLICATION OF

THE HONORARY MATHEMATICAL FRATERNITY

VOLUME 1 NUMBER 2

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APRIL 1950

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OF THE HONORARY MATHEMATICAL FRATERNITY

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PI MU EPSILON JOURNAL is published semi-annually at Syracuse University.

MANUSCRIPTS should be addressed to the Editor, Ruth W. Stokes, 15 Smith Hall, Syracuse University, Syracuse 10, New York.

ADVERTISING CORRESPONDENCE should be addressed to Howard C. Bennett, 15 Smith Hall, Syracuse University, Syracuse 10, New York.

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FLOYD FISKE DECKER*
1881 - 1949

THE death of Dr. Floyd Fiske Decker, November 28, 1949, brings to a close a life devoted to the teaching of mathematics. Born March 23, 1881, at Dennison, Texas, he spent his undergraduate years, 1897-1901, at Syracuse University where he received the degrees of Ph.B., 1901, Ph.M., 1905, Ph.D., 1910.

Following some outside teaching, Dr. Decker returned to Syracuse University where he was a member of the mathematics faculty from 1904 to the time of his death.

He belonged to various honorary societies but was always most closely associated with those of the department of which he was a member. He was a member of the first mathematics club of the University and a charter member of Pi Mu Epsilon. At the founding of Pi Mu Epsilon, Dr. Decker was elected the first vice-director.

Aside from his work in mathematics he will be remembered especially for his work as the first Director of the Extension School, now known as University College. Plans for the Extension School occupied his mind during his waking hours from the beginning of the school until it became so large that a full-time director was necessary. Dr. Decker's efforts had already placed the school on a firm foundation.

Dr. Decker will be long remembered by the many members of the faculty with whom he was associated and by the many grateful students who passed through his classes, for he was a patient, thorough and conscientious teacher.

In 1910, he married Mary Makepeace, a member of the class of 1907, besides whom he leaves a daughter, Mrs. Elizabeth Corwin, a son, Robert Decker, and two grandchildren.

Louis Lindsey

*Dr. Decker was the author of the article "The Earliest Days of Pi Mu Epsilon" which appeared in the first issue of this Journal.

AN APPROXIMATION FOR THE DIP OF A CATENARY

By J. S. Frame
Michigan State College

Let a uniform inextensible cable or chain of length 2s (ft.) be hung between supports A, B at the same level and at distance AB = 2x (ft.) apart, where x is less than s. Then the dip or sag y (ft.) from the line AB to the lowest point O on the curve may be closely approximated by the rather simple formula

$$y^2 \cong (s - x)\,(s + x/2). \tag{1}$$

The value of y computed from (1) is in error by less than one part in 117, for all values of x less than s.*

If ρ is the constant linear density of the catenary, and if $H = \rho a$ and $W = \rho s$ denote the horizontal and vertical components of force at a variable point P of the curve, and if we introduce a parameter u such that sinh u is the slope of the curve at P, then

$$\sinh u = dy/dx = W/H = s/a. \tag{2}$$

$$\cosh u = (1 + \sinh^2 u)^{1/2} = ds/dx. \tag{3}$$

After differentiating equation (2) and using (3), we have

$$\cosh u\, du = ds/a = \cosh u\, dx/a. \tag{4}$$

We can express dx, dy and ds in terms of du by using (4), (2), and (3), and can then integrate to find x, y and s in terms of u, keeping a constant and noting that y = s = 0 when x = 0. Thus

$$dx = a\, du, \quad dy = a \sinh u\, du, \quad ds = a \cosh u\, du. \tag{5}$$

$$x = a u, \quad y = a(\cosh u - 1), \quad s = a \sinh u. \tag{6}$$

*Professor E. P. Starke has called my attention to another approximation for the dip of a catenary, published as the solution of a problem in the National Mathematics Magazine (Feb. 1945, p. 262, Problem 570) but valid only for small values of the ratio x/s.

The relative error of the approximation (1) may now be written as a function F(u) of the parameter u. The parameter a, which was constant for a particular catenary, must be eliminated in order that the approximation should not involve the unknown location of the directrix (y = -a) of the catenary. We have

$$(7)\quad F(u) = 1 - \frac{(s-x)\,(s+x/2)}{y^2} = 1 - \frac{(\sinh u - u)\,(\sinh u + u/2)}{(\cosh u - 1)^2}$$

$$= \frac{N(u)}{2(\cosh u - 1)^2},$$

where the numerator N(u) in (7) is given by

$$(8)\quad N(u) = 2(\cosh u - 1)^2 - 2\sinh^2 u + u \sinh u + u^2$$

$$= u^2 + u \sinh u - 4(\cosh u - 1).$$

The fact that N(u) is non-negative may be seen by writing

$$(9)\quad N(u) = u(\sinh u - u) - 4(\cosh u - 1 - u^2/2)$$

$$= \sum_{n=3}^{\infty} \frac{(2n-4)u^{2n}}{(2n)!} \geq 0.$$

Thus we conclude that the relative error function F(u) is positive for positive u, increases from 0 like $u^2/180$ for small u, and decreases towards 0 again like $(u-4)e^{-u}$ as u becomes infinite. To find the value of u for which F(u) is maximum, we set the numerator of the derivative of F(u) equal to 0. We then have

$$(10)\quad 2(\cosh u - 1)^2 N'(u) - 4(\cosh u - 1)\sinh u\, N(u) = 0.$$

This equation may be transformed into the form

$$(11)\qquad \frac{2N(u)}{\cosh u - 1} - \frac{N'(u)}{\sinh u} = 0.$$

When the values of N(u) and its derivative N'(u) are substituted from (8) into (11), the condition for maximum F(u) becomes

$$(12)\qquad G(u) = \frac{2u^2}{\cosh u - 1} + u \coth u = 5.$$

Solving equation (12) requires special care in computation,

since the function G(u) differs but little from 5 for small values of u. This is seen from the following table of values

(13)

u	0	1	2	3	4
G(u)	5.0000	4.9959	4.9705	4.9999855	5.2187

The positive value of u for which G(u) = 5, or F'(u) = 0, is found to be just greater than u = 3.00. For this particular parameter value the dip y is nearly 1.5 times as great as the distance 2x between supports. The maximum relative error F(u) in y^2 is then found from accurate tables of hyperbolic functions to be

(14) $$\text{Max } F(u) = F(3.00+) = 0.017.$$

For y itself, as computed from (1), the relative error is half this amount, or about 0.0085. The computed value is always too small, since F(u) is positive for positive u. Should an approximate formula for dip be desired which has four place accuracy but does not explicitly involve the hyperbolic functions, the relative error of y may be fitted by a rational function. We leave it to the reader to show that the dip (or sag) of a catenary is given accurately to four significant figures by the formula

(15) $$y = \sqrt{(s-x)\,(s+x/2)}\;\left(1 + \frac{0.85\,x(s-x)}{s(9s+40x)}\right).$$

The applied mathematician may perhaps wonder how formula (1) should be altered to allow for elastic stretching according to Hooke's Law. Let us replace the inextensible catenary by a flexible elastic cord of unstretched length 2L and weight 2W, and define k = W/2E, where E is Young's modulus. Then when the two ends are together the midpoint will hang down a distance L(1 + k). If we again define sinh u to be the slope of the curve at a point P, the parametric equations for the coordinates (x,y) of the endpoint B and for the stretched arc OB = s turn out to be

(16) $$\frac{x}{L} = \frac{u+2k}{\sinh u},\ \frac{y}{L} = \tanh\frac{u}{2} + k,\ \frac{s}{L} = 1 + k\frac{u + \sinh u \cosh u}{\sinh^2 u}.$$

We leave it to the ingenuity of the reader to find a simple approximate relationship between the variables x/L, y/L and k, that does not involve the parameter u but does reduce to formula (1) when k = 0 and L = s.

THE NUMBER OF SOLUTIONS OF THE TOTIENT EQUATION $\varphi(x) = B$

By Richard V. Andree,
University of Oklahoma

The totient of Euler φ-function $\varphi(x)$ is defined for positive integers x as the number of positive integers less than or equal to x which are relatively prime to x.

A student of elementary number theory attempting to solve the equation $\varphi(x) = 24$, where $\varphi(x)$ is the Euler φ-function or totient, finds $x = 39, 52, 56, 72, 78, 84, \ldots$ and other values. The question arises, quite naturally, if there always exist only a finite number of solutions of $\varphi(x) = B$, or if, for some B at least, there may exist infinitely many such x. That there do not exist infinitely many solutions for all B is at once obvious from the cases where $B = 3$ and $B = 1$. The former has no solution while the latter has only the solutions $x = 1$ and $x = 2$.

The answer to this question may be obtained by specializing certain rather powerful theorems which the graduate student has at his disposal. The purpose of this note, however, is to give the answer in a form simple enough for the undergraduate or beginning graduate student taking number theory.

Theorem: Given a positive integer B, there exists a number N_B such that for all $x > N_B$, $\varphi(x) > B$.

If $B = 1$, take $N_B = 2$.

If $B > 1$, there exist only a finite number of primes $p_i \leq B + 1$. Call these $p_1, p_2, \ldots, p_n$.

Since $\varphi(p^{\alpha}) = p^{\alpha} - p^{\alpha-1}$ we have, at once,

$$1 = \varphi(p_1^{0}) \leq \varphi(p_1) < \varphi(p_1^{2}) < \varphi(p_1^{3}) < \ldots < \varphi(p_1^{k}) < \ldots .$$

Thus there exist only a finite number of prime powers $p_i^{\gamma_i}$ such that

$$\varphi(p_i^{\gamma_i}) \leq B.$$

Let $\alpha_i \geq 0$ be the maximum exponent satisfying

$$\varphi(p_i^{\alpha_i}) \leq B.$$

All powers of all primes, except the finite collection

$$p_1, p_1^2, p_1^3, \cdots, p_1^{\alpha_1}, p_2, p_2^2, \cdots, p_2^{\alpha_2}, p_3, \cdots, p_n^{\alpha_n}$$

have $\varphi(q^{\delta}) > B$, since if $q > B + 1$ and q prime, then

$$\varphi(q^{\delta}) = q^{\delta-1}(q-1) > B.$$

Let $N_B = \Pi p_i^{\alpha_i}$. For every $x = \Pi r_i^{\beta_i} > N_B$, at least one of the prime power factors $r_i^{\beta_i}$ must be such that $\varphi(r_i^{\beta_i}) > B$. Hence, since $\varphi(mn) = \varphi(m)\varphi(n)$ if m and n are relatively prime, we have

$$\varphi(x) > B \text{ for all } x > N_B = \Pi p_i^{\alpha_i}.$$

The question proposed in the first paragraph is now answered in the following immediate corollary.

Corollary: There exist at most a finite number of solutions of $\varphi(x) = B$.

An additional problem of this type which the beginning student should be expected to work is "Show that, for all odd primes p, $\varphi(x) = p$ has no solution." The maverick nature of the prime 2 is again displayed.

ERRATA

The following errata in Volume 1, Number 1, have been called to the attention of the editors:

J. S. Frame, "Note on the Product of Power Sums." Page 19, line 13, formula (7), insert t in right member of equation so that it reads $tG(n,t)-1/2t(e^{nt}-1)$. Page 19, last line, formula (9), replace

$$(2k^p - 1) \text{ by } \binom{p}{2k-1}.$$

Problem 7. Proposed by Arthur Rosenfeld, N.Y.C.

Page 23, change $\binom{Q}{j}$ to $\binom{Q}{j}$.

Problem 10. Proposed by P. L. Chessin, Columbia University.

Page 24, change $(a + nd)x^n!$ to $(a + nd)\frac{x^n}{n!}$.

PROBLEM DEPARTMENT

This department welcomes problems believed to be new and, as a rule, demanding no greater ability in problem solving than that of the average member of the Fraternity, but occasionally we shall publish problems that should challenge the ability of the advanced undergraduate and/or candidate for the master's degree. Solutions of these problems should be submitted on separate, signed sheets within five months after publication. Address all communications concerning problems to the Editor.

PROBLEMS FOR SOLUTION

12. Proposed by C. O. Oakley, Haverford College

(Note. This problem has appeared elsewhere, but because it is a timely problem it has been reprinted.)

The Census Enumerator Problem

A census enumerator goes to a house and notes the number of the house. The man who answers the door bell gives the enumerator his age and adds that there are three other members of his household. But he refuses to give the ages of the other three. Instead he says, "The product of their ages is 1296 and the sum is equal to the house number." The enumerator, after some computing, says, "I need some more information. Are you the oldest member of the household?" The man replied, "Yes." The enumerator now has enough information to compute the ages of the other three and so have you.

13. Proposed by W. R. Ransom, Tufts College

An electric clock has hour, minute and second hands turning about the same axis. Prove that they are never together except at twelve o'clock.

14. Proposed by C. W. Trigg, Los Angeles City College

1. How may a sealed envelope be folded into a rectangular parallelepiped if overlapping is permitted? 2. What is the maximum volume so obtainable in terms of the edges a and b of the envelope? 3. What must be the relative dimensions of the envelope in order to yield a cube? 4. What will be the volume of the cube?

15. Proposed by Lester G. Riggs, Evanston, Illinois

(Note. The proposer does not claim to have originated this problem.)

Russian Multiplication

Consider any two positive integers x_1 and y_1 and the table

y_1	y_2	...	y_k
x_1	x_2	...	x_k

.

The x and y values are formed according to the laws:

$y_{n+1} = 2y_n$, $x_{n+1} = \frac{x_n}{2}$ for x_n even, $x_{n+1} = \frac{x_n - 1}{2}$ for x_n odd,

$x_k = 1$ for $n = 1, 2, \ldots, k-1$.

Prove that

$$x_1y_1 = y_{p_1} + y_{p_2} + \ldots + y_{p_k}$$

where the $p_1, p_2, \ldots, p_k$ are such that $x_{p_1}, x_{p_2}, \ldots, x_{p_k} = 1$ are all of the odd x values.

Examples:

(a)

7	~~14~~	~~28~~	56
9	~~4~~	~~2~~	1

; $9 \cdot 7 = 7 + 56 = 63$.

(b)

~~13~~	~~26~~	52	~~104~~	208
~~20~~	~~10~~	5	~~2~~	1

; $20 \cdot 13 = 52 + 208 = 260$.

(c)

56	112	~~224~~	448	~~896~~	1792	~~3584~~	7168
171	85	~~42~~	21	~~10~~	5	~~2~~	1

;

$171 \cdot 56 = 56 + 112 + 448 + 1792 + 7168 = 9576.$

16. Proposed by W. J. Jenkins, Livingston, Alabama

Given a circle and two exterior points not in a straight line with the center. Construct a circle passing through these two points and dividing the given circle into two equal arcs.

17. Proposed by C. Stanley Ogilvy, Columbia University

All the coefficients in the expansion of $(a + b)^n$ except the first and the last are divisible by n if and only if n is a prime.

(Note. The proposer gives the complete proof and remarks that the sufficiency proof is given in another connection in Van der Waerden, page 93 of the English translation; but, he adds, he has not yet found in print the necessity part of the proof.)

18. Proposed by Lindley J. Burton, Bryn Mawr College

Points A_1, B_1, C_1, are chosen on the sides BC, CA, AB of triangle ABC such that $AC_1 = 1/2C_1B$, $BA_1 = 1/2A_1C$, $CB_1 = 1/2B_1A$. The lines AA_1, BB_1, CC_1 determine a triangle $A_2B_2C_2$. Show that the area of $A_2B_2C_2$ is one seventh the area of ABC.

19. Proposed by E. P. Starke, Rutgers University

Given two polynomials of degree n,

$$f(x) \equiv a_0x^n + a_1x^{n-1} + \ldots + a_n,$$

$$g(x) \equiv b_0x^n + b_1x^{n-1} + \ldots + b_n,$$

and n + 1 arbitrary constants $k_1, \ldots, k_{n+1}$, not necessarily distinct; if

$f(k_1) = g(k_1)$, $f'(k_2) = g'(k_2)$, $f''(k_3) = g''(k_3)$, . . . ,

$f^{(n)}(k_{n+1}) = g^{(n)}(k_{n+1})$, then $f(x) = g(x)$ identically.

20. Proposed by Murray S. Klamkin, Brooklyn Polytechnic Institute

Show that

$$\frac{b^b - a^a}{b(1 + \ln b)} < \int_a^b x^{x-1}\,dx < \frac{b^b - a^a}{a(1 + \ln b)}, \quad b > a > 1.$$

SOLUTIONS

2. Proposed by the Problem Editor

Instrumental errors may often be made to react against themselves and automatically disappear. A simple example is the process of "double weighing," in which the effect of inequality in the arms of the balance is removed by weighing with the object first on one pan, then on the other, and taking an appropriate mean. Several texts say that the arithmetic mean should be taken. Show that this is not true, and find the correct mean.

Solution by Lawrence Bennett, Brooklyn College

The weight to be found is W. We shall consider two cases. In the first, the weight W, at a distance d_1 from the fulcrum, is balanced by a standard weight S_1 at a distance d_2 from the fulcrum; in the second, W, at a distance d_2 from the fulcrum, is balanced by a second standard weight S_2 at a distance d_1 from the fulcrum, where S_2 will be different from S_1 if $d_1 \neq d_2$.

By the law of the lever, for the first case,

$$d_1 W = d_2 S_1,$$

and

$$d_1 S_2 = d_2 W$$

for the second. This gives

$$W = \frac{d_2}{d_1} S_1 \qquad \text{and} \qquad W = \frac{d_1}{d_2} S_2 .$$

Eliminating W, we get

$$S_1 = \frac{d_1^2}{d_2^2} S_2 .$$

The geometric mean will then give:

$$\sqrt{S_1 S_2} = \sqrt{\left(\frac{d_1^2}{d_2^2} S_2\right)(S_2)} = \frac{d_1}{d_2} S_2 = W.$$

The arithmetic mean is

$$\frac{S_1 + S_2}{2} = \frac{\frac{d_1^2}{d_2^2} S_2 + S_2}{2} = \frac{d_1}{d_2} S_2 \left[\frac{d_1}{2d_2} + \frac{d_2}{2d_1}\right].$$

Suppose $\frac{d_2}{d_1} = a$, then

$$\frac{S_1 + S_2}{2} = \frac{d_1}{d_2} S_2 \left[\frac{1}{2a} + \frac{a}{2}\right] = W \left[\frac{1}{2a} + \frac{a}{2}\right]$$

$$= W \left[\frac{a^2 + 1}{2a}\right].$$

Then the arithmetic mean will equal W only if

$$\frac{a^2 + 1}{2a} = 1,$$

$$a^2 - 2a + 1 = 0,$$

$$a = 1,$$

which gives $d_1 = d_2$.

In other words, the arithmetic mean is correct only in the case of exactly equal arms.

Also solved by C. W. Trigg, Los Angeles City College.

3. Proposed by the Problem Editor

The lengths of the sides of a triangle are the roots of the cubic equation $ax^3 + bx^2 + cx + d = 0$. Find the area of the triangle.

Solution by Lawrence Bennett, Brooklyn College

The area of the triangle is

$$A = \sqrt{s(s-x_1)(s-x_2)(s-x_3)},$$

where

$$s = \frac{x_1 + x_2 + x_3}{2}$$

and x_1, x_2, x_3 are the roots of the cubic $ax^3 + bx^2 + cx + d = 0$.

$$A = \sqrt{s^4 - s^3(x_1+x_2+x_3) + s^2(x_1x_2+x_2x_3+x_3x_1) - s(x_1x_2x_3)}$$

But $$s = \frac{x_1 + x_2 + x_3}{2} = -\frac{b}{2a},$$

and $$x_1 + x_2 + x_3 = -\frac{b}{a},$$

$$x_1x_2 + x_2x_3 + x_3x_1 = \frac{c}{a},$$

$$x_1x_2x_3 = -\frac{d}{a}.$$

$$A = \sqrt{\left(\frac{-b}{2a}\right)^4 - \left(\frac{-b}{2a}\right)^3\left(\frac{-b}{a}\right) + \left(\frac{-b}{2a}\right)^2\left(\frac{c}{a}\right) - \left(\frac{-b}{2a}\right)\left(\frac{-d}{a}\right)}$$

$$= \sqrt{\frac{b^4}{16a^4} - \frac{b^4}{8a^4} + \frac{b^2c}{4a^3} - \frac{bd}{2a^2}}$$

$$= \frac{1}{4a^2}\sqrt{-b^4 + 4ab^2c - 8a^2bd}\,.$$

Also solved by C. W. Trigg who lists the following references.

(1) School Science and Mathematics, Nov. 1936, vol. 36, p. 915. It is shown there, also, that the altitudes of the triangle are the roots of $8a^2R^3X^3 - 4acR^2X^2 + 2bdRX - d^2 = 0$, where R is the circumradius.

(2) The American Mathematical Monthly, May 1925, vol. 32, p. 266. It is shown that if the roots of a cubic equation considered as lengths are to form a triangle then the discriminant of the cubic must be positive and b and $(4abc - 8a^2d - b^3)$ must have like signs, $a > 0$.

4. Proposed by the Problem Editor

Towards the bottom of page 268 of Cajori's "A History of Mathematics" (1926) we find the following statements: "Napoleon proposed to the French mathematicians the problem, to divide the circumference of a circle into four equal parts by the compasses only. Mascheroni does this by applying the radius three times to the circumference; he obtains the arcs AB, BC, CD; then AD is a diameter; the rest is obvious." Show how the "obvious" part of the problem may be accomplished.

Solution by John A. Dyer, University of Alabama

Napoleon's problem may be stated as follows: By use of compasses only find the side of a square inscribed in a given circle O, radius R, given also the consecutive points A, B, C, D on the circumference such that AB = BC = CD = R, and AD a diameter.

Now, with A as center and radius AC, draw circle A. Similarly, with D as center and radius DB, draw circle D. Circles A and D intersect at points, say E and E'. Then OE is the required side of the inscribed square.

7. Proposed by Arthur Rosenfeld, N.Y.C.

Prove that $\sum_{j=0}^{R} \binom{Q}{j}\binom{Q-j}{R-j} = \binom{Q}{R} 2^R$.

Solution by Ben A. Green, University of Alabama

We have by definition

$$\sum_{j=0}^{R} \binom{Q}{j}\binom{Q-j}{R-j} = \sum_{j=0}^{R} \left[\frac{Q!}{j!(Q-j)!} \cdot \frac{(Q-j)!}{(R-j)!(Q-R)!}\right].$$

Since $(Q-j)!$ divides out, and $\frac{Q!}{(Q-R)!}$ is independent of the index of summation, we may write this as

$$\frac{Q!}{(Q-R)!} \sum_{j=0}^{R} \frac{1}{j!(R-j)!}.$$

Multiplying numerator and denominator by $R!$ gives

$$\frac{Q!}{R!(Q-R)!} \sum_{j=0}^{R} \frac{R!}{j!(R-j)!}, \text{ which is notationally,}$$

$$\binom{Q}{R} \sum_{j=0}^{R} \binom{R}{j}.$$

However, in the binomial expansion

$$(a+b)^R = \sum_{j=0}^{R} \binom{R}{j} a^{R-j} b^j, \text{ place } a = b = 1$$

and get $$\sum_{j=0}^{R} \binom{R}{j} = (1+1)^R = 2^{R*}$$

Thus we have

$$\sum_{j=0}^{R} \binom{Q}{j}\binom{Q-j}{R-j} = \binom{Q}{R} 2^R .$$

*Note: Reference is made to the fact that $\sum_{j=0}^{R} \binom{R}{j} = 2^R$ in one form or another, in the following:

(1) Courant, Differential and Integral Calculus, Nordemann, New York, 1940, vol. 1, p. 28.
(2) Ferror, Convergence, Oxford Univ., London, 1945, Prob. 7.
(3) Fine, College Algebra, Ginn, Boston, 1904, p. 402.
(4) Hall and Knight, Higher Algebra, Macmillan, London, 1946, p. 146.
(5) Whitworth, Choice and Chance, Stechert, New York, 1942, p. 48.

Also solved by C. W. Trigg, Los Angeles City College, Sherman Babcock, Syracuse University, as well as the proposer, Arthur Rosenfeld, N. Y. C.

10. Proposed by P. L. Chessin, Columbia University

Sum the series

$$a + (a+d)x + (a+2d)x^2/2! + \ldots + (a+nd)x^n/n! + \ldots .$$

Solution by H. Pitt, University of Wisconsin

We denote the sum of the series by S, then show that $S = a + (a+d)x + (a+2d)x^2/2! + \ldots + (a+nd)x^n/n! + \ldots$.

By the ratio test, this series is absolutely convergent. Hence, rearranging the terms, we have

$$S = (a+ax+ax^2/2! + \ldots + ax^n/n! + \ldots) + (dx+2dx^2/2!+3dx^3/3!+ \ldots + ndx^n/n! + \ldots)$$

$$= a(1+x+x^2/2! + \ldots + x^n/n! + \ldots) + dx(1+x+x^2/2! + \ldots + x^{n-1}/(n-1)! + \ldots)$$

$$= ae^x + dxe^x$$

$$= (a + dx)e^x.$$

Also solved by Lawrnece Bennett, Brooklyn College, Sherman Babcock, Syracuse University, besides the proposer, P. L. Chessin, Columbia University.

* * *

To drive a car through the main gate of Syracuse University campus is a privilege reserved for the Chancellor, the Vice-Chancellor, the Deans, the Department Heads, and a few other important persons. This privilege is indicated by a "campus sticker" on the windshield.

Recently a student from the New York State College of Forestry with no sticker on his car drove up and said to the guard, "I've a whole box of logarithms in this car." The guard with no hesitation replied, "O.K., go ahead."

* * *

The different branches of Arithmetic — Ambition, Distraction, Uglification, and Derision.

— The Mock Turtle (Alice in Wonderland)

EXCERPTS FROM LETTERS TO THE EDITORS

BEFORE and AFTER
Publication of the First Issue of the Journal

— BEFORE —

" . . . I appreciate very much being one of the authors selected for the new publication.

"I am very happy to hear that Pi Mu Epsilon is publishing such a journal, believing that it could greatly help students as well as stimulate them. I assume that the articles will be written by undergraduates, for the most part, and will not be 'too advanced.' . . . "

"I wish Pi Mu Epsilon all good fortune in general, the new publication in particular."

Melvin Hausner
Oct. 25, '49 Princeton University

"The members to whom I have spoken personally think the publication is a splendid idea and share the hope that it will become a permanent institution."

W. S. Beckwith
Nov. 15, '49 University of Georgia

"This publication should be most helpful and interesting. Thank you for sponsoring the project."

W. M. Whyburn, Cor. Sec'y.,
N. C. Beta and Dept. Head
Nov. 16, '49 University of North Carolina

"California Alpha Chapter of Pi Mu Epsilon is glad to hear of the Journal to be published."

Margaret B. Lehman, Cor. Sec'y.
California Alpha
Nov. 16, '49 University of California at Los Angeles

"...I am sure that all members of the Fraternity are eagerly awaiting the appearance of this first issue of the Journal. I feel that it is a worthwhile project which will make the student members more fully aware of the national scope of the Fraternity. The sponsors are to be commended for supporting the project financially, and the Committee on Publication is to be congratulated for completing preparations for the first issue in so short a time."

H. S. Thurston, Secretary
Alabama Alpha
Nov. 17, '49 University of Alabama

"We are looking forward with interest to this first issue of the PI MU EPSILON JOURNAL."

Dorothy J. Christensen, Sec'y.-Treas.
Oregon Alpha
Nov. 23, '49 University of Oregon

"...The idea of bringing out a journal at this time is an excellent one. If there is anything that we can do to help you along in this venture let us know.

"Best wishes for the success of the publication."

William A. Golomski, Director
Wisconsin Alpha
Dec. 4, '49 Marquette University

— AFTER —

"Congratulations on a very excellent Journal! I think that you and Mr. Bennett deserve a great deal of credit on getting out such an attractive magazine on so small an appropriation. I am sure that the Fraternity will be pleased with it."

C. C. MacDuffee, Director-General
Pi Mu Epsilon Fraternity
Dec. 20, '49 University of Wisconsin

"The new PI MU EPSILON JOURNAL has arrived and I can't resist writing to congratulate you upon its appearance. Ever since the discussion at the Columbus meetings last year many of us have been looking forward to this first issue."

Richard V. Andree
Ass't. Prof. of Math
Dec. 29, '49 University of Oklahoma

"Thank you very much for letting me have a copy of the PI MU EPSILON JOURNAL. I have read it with much interest. I am sure that it will equally interest other mathematicians including undergraduate members of the Fraternity."

Harry M. Gehman, Sec'y.-Treas. MAA
Jan. 3, '50 University of Buffalo

"Let me add to the many congratulations you must be receiving concerning the first issue of the PI MU EPSILON JOURNAL. The entire issue is excellent and so neat in appearance. It was also a pleasure to read the historical articles written by my good friends Professor Harwood and Professor Decker."

Howard Eves
Jan. 6, '50 Oregon State College

"I am delighted to have a PI MU EPSILON JOURNAL. I feel you are to be congratulated on the fine work you have done in connection with this."

Eric H. Faigle, Assoc. Dean
Jan. 9, '50 Syracuse University

"You and all the others who worked on the first number of Volume I of the PI MU EPSILON JOURNAL are to be congratulated on a fine job. It is grand in every respect and I enjoyed reading it. Best wishes for continued success."

Houston T. Karnes, Sec'y.
Louisiana Alpha
Jan. 10, '50 Louisiana State University

"The Michigan Alpha Chapter of Pi Mu Epsilon and I should like to congratulate you on the first issue of the PI MU EPSILON JOURNAL. It is indeed a fine job, and we are eagerly awaiting the publication of the next issue."

Lindbergh C. Vogt
Jan. 15, '50 Michigan State College

"Our library was pleased to receive v.1, #1 of PI MU EPSILON JOURNAL. We trust that the name of our library was placed on your mailing list to receive all future numbers as issued."

Frances Warner, Serials Librarian
Jan. 25 '50 Iowa State College

"Both you and Mr. Bennett are to be congratulated on the preparation and publication of the first issue of the PI MU EPSILON JOURNAL. The biography of Professor Roe will be welcomed by every member of Pi Mu Epsilon and the description of the earliest days of Pi Mu Epsilon by Professor Decker contained some very interesting material. You provided a good balance of other material too in the two additional articles, the problem department, the reports of the chapters' activities and prizes awarded, and the news notes. You have certainly accomplished the purpose proposed by the Council in providing a journal which should do much to service the various needs of our chapters."

E. H. C. Hildebrandt, Sec.-Treas.-Gen.
Pi Mu Epsilon Fraternity
Feb. 2, '50 Northwestern University

"I am writing to acknowledge and to thank you for the complimentary copy of Volume I, Number 1, of the PI MU EPSILON JOURNAL.

"...I feel that there is a real need for a journal addressed to the interests of advanced undergraduates and candidates for the Master's degree, and that the PI MU

EPSILON JOURNAL might find a real niche for itself in this field."

H. M. MacNeille, Executive Director
American Mathematical Society
March 24, '50 Columbia University

"Purchase Order, DUKE UNIVERSITY, Durham, N. C. ... PI MU EPSILON JOURNAL.

SUBSCRIPTION TO VOLUME I AND CONTINUATION. UPON EXPIRATION OF THIS SUBSCRIPTION PLEASE ENTER RENEWAL EACH YEAR UNTIL FURTHER NOTICE."

(signed)
B. E. Powell, for the
April 5, '50 Duke University Library

"I appreciate receiving the first issue of PI MU EPSILON JOURNAL. I enjoyed reading the Journal and I feel that the Committee in charge should be highly commended for their efforts.

"I would like very much to be put on your mailing list and to subscribe to the publication as soon as the subscription rates are set up."

Frances E. Walsh
April 15, '50 Atchison, Kansas

"...I had intended a long time ago to write you and tell you what a good job I feel was done on the PI MU EPSILON JOURNAL. I think it will fill a real need and that it will be much appreciated by all who read it. I shall look forward to future issues. I hope you will also extend my congratulations to Mr. Bennett for the part he played in connection with the periodical...."

S. S. Cairns
Head of Math. Dept.
April 18, '50 University of Illinois

REPORTS OF THE CHAPTERS

(Send reports to Ruth W. Stokes, 15 Smith Hall, Syracuse University, Syracuse 10, New York.)

EDITOR'S NOTE. According to Article VI, Section 3 of the Constitution: "The Secretary shall keep account of all meetings and transactions of the chapter and, before the close of the academic year, shall send to the Secretary-General and to the Director-General, an annual report of the chapter activities including programs of meetings, results of elections, etc." The Secretary-General now suggests that a copy of the annual report of each chapter be sent to the editor of the PI MU EPSILON JOURNAL. Besides the information listed above we are especially interested in learning what the chapters are doing by way of competitive examinations, medals, prizes and scholarships. These annual reports will be published in the chronological order in which they were received.

Alpha of Oregon, University of Oregon

During the academic year 1948-1949, the following papers were read before the Oregon Alpha chapter:

"The Canadian Mathematical Congress" by Professor K. S. Ghent

"Proof that a trigonometric function of an angle having an integral number of seconds is an algebraic number" by Walter Gilbert

"Correlation theory" by Professor Fréchet of the University of Paris

"Fourier series" by Shirley K. Anderson

"Mathematics of life insurance" by Frank Howatt

"A generalization of the average of two numbers" by Professor B. H. Arnold of Oregon State College.

The officers elected for 1949-50 are: Director, John E. Olson; Vice-Director, Carl Pride; Secretary-Treasurer, Gene Thompson.

Gamma of Missouri, St. Louis University

Papers presented before the Missouri Gamma chapter during the academic year 1948-1949 were:

"Generating functions" by Reverend Charles Rust, S. J.

"Newton's polygon in higher plane curves" by Reverend J. E. Case, S. J.

"Special methods of integration" by Charles Koerner

"The concept of area in plane geometry" by Professor C. C. MacDuffee, University of Wisconsin and Director-General of Pi Mu Epsilon.

The officers elected during the year were: Director, Edward Thirkhill; Vice-Director, William Felling; Secretary, Virginia Herre; Faculty Adviser, Dr. Francis Regan.

On the afternoon and evening of April 19, 1950, with the following program, the Missouri Gamma chapter concluded its activities for the current year.

3:00 P.M., initiation of new members and election of a new director

4:00 P.M., lecture, "Life with Statistics," by Professor George W. Snedecor of Iowa State College

5:15 P.M., reception honoring Professor Snedecor

6:30 P.M., annual banquet.

Alpha of Louisiana, Louisiana State University

Papers presented before the Louisiana Alpha chapter during the academic year 1948-1949 were:

"Applications of complex numbers" by Professor B. B. Townsend

"Coordinate systems" by M. C. Wicht

"Mathematics of the atomic bomb" by Professor F. B. Rickey

"Straight line construction of conic sections" by Ernest Ikenberry

"Laplace transforms" by Miss Margaret LaSalle

"Osculating figures" by Donald Shipp.

The chapter had as guest speaker, for the Pi Mu Epsilon Lecture Series, Professor Saunders MacLane of the University of Chicago. He discussed "What is topology?" and "Cohomology theory for groups."

Officers for the year 1948-49 were: President, Donald Shipp; Vice-President, Marion Smith; Secretary, Alice Pecot; Treasurer, Frank Woolam; Faculty Adviser and Corresponding Secretary, Professor H. T. Karnes.

(On March 6, 1950, the Editor received from Professor H. T. Karnes a more detailed report of the work of the Louisiana Alpha chapter. Because it is such an excellent report we have printed it in its entirety. The paragraph on awards appears elsewhere in this issue.)

1. Our chapter is quite an active group, having twelve to fifteen meetings per year. All of these are program meetings wherein someone gives an hour lecture on some phase of mathematics, with the exception of our first fall meeting (which is organizational) and the banquet following our iniation.

2. (Please see section on MEDALS, PRIZES and SCHOLARSHIPS.)

3. Our chapter sponsors a shelf in the Mathematics Library. Several volumes are added to this collection each year. The books are of the type which the department would not ordinarily buy for research purposes, such as histories, biographies and mathematics of more or less a popular nature, if I may be pardoned for using this expression.

4. Our chapter sponsors a guest lecturer to the campus each year who gives two lectures: an afternoon lecture devoted to pure mathematics and an evening lecture at which time the speaker uses a mathematics topic but makes an effort to present it in a way that students and faculty members not thoroughly acquainted with mathematics may receive something of interest.

Alpha of North Carolina, Duke University

Papers presented before the North Carolian Alpha chapter during the academic year 1948-1949 were:

"Mathematical analysis of mechanisms used in automatic machinery" by Mr. John May of Wright's Automatic Machinery Company. (Following the presentation of this paper was a tour of Professor W. W. Rankin's Mathematics Laboratory.)

"Maxima and minima" by Dr. W. M. Whyburn, Head of the Mathematics Department of the University of North Carolina.

There were 57 new members initiated during the year.

The officers elected for 1949-50 are: President, John Putnam; Vice-President, Edwin Webb; Secretary, Janet Henchie; Treasurer, Charles Gassett; Membership Chairman, Pat Collins.

Alpha of Missouri, University of Missouri

Papers presented before the Missouri Alpha chapter during the academic year 1948-1949 were:

"Functions defined by more than one equation" by Dr. G. M. Ewing

"Mathematics as a career" by Dr. L. M. Blumenthal

"The students' points of view on mathematics courses" by a panel of students

"Saturn and the Moon" by Dr. E. S. Hayner of the Astronomy Department

"Mathematics and vagueness" by Dr. W. D. Oliver of the Philosophy Department.

Newly elected officers are: President, William Nichols; Vice-President, Martin Smith; Secretary, Walter Hickman; Treasurer, Jesse Corder.

Alpha of Oklahoma, University of Oklahoma

The first meeting of the Oklahoma Alpha chapter for the 1948-1949 session was a business meeting at which the following officers were elected: Director, Lowell Gregory; Vice-Director, Richard Yeilding; Secretary-Treasurer, Gerald Webster.

The following papers were presented during the year:

"The five-color conjecture" by Dr. Arthur Bernhart

"The effects of atmospheric disturbances on projectiles" by Otis Spears

"Eigenfunctions and limits to the characteristic roots of a matrix" by Lowell Gregory

"Cybernetics" by Dr. Carlton Berenda

"Galois theory" by Miss Ann Sheldon.

Dr. J. Rud Nielsen, Research Professor of Physics, was the speaker at the annual initiation banquet. His subject was "The Roman effect."

Gamma of Pennsylvania, Lehigh University

The Pennsylvania Gamma chapter held five regular meetings during the academic year 1948-1949 besides an initiation banquet. The following papers were presented:

"The Laplace transform" by Professor R. Stoll

"The Laplace transform," a second paper, by J. Harry Dowling

"Some approximation methods" by Professor C. Shook

"The deviation of the Lorentz equation" by Mr. Alperin

"Some boundary value problems" by Professor Beer.

At the initiation banquet Professor A. Pitcher gave an interesting talk on topology entitled "The ham sandwich problem."

Officers elected for the following year were: Director, Professor R. Stoll; President, Richard Orford; Vice-President, James Fulleylove; Secretary, Albert Christy; Treasurer, Charles Close.

MEDALS, PRIZES AND SCHOLARSHIPS

EDITOR'S NOTE. Each chapter will undoubtedly be interested in learning what other chapters are doing along the line of prize competitions. So the editor makes the request that chapters offering prizes, scholarships, or other awards, write up their plans for such contests and submit them for publication in this journal.

EXCERPTS FROM ANNUAL REPORTS

"Ten dollars was contributed to the E. E. DeCou mathematics prize. This prize, in honor of the former head of the mathematics department, was started this year and will be given to an outstanding upper division student in mathematics."

—Oregon Alpha Chapter.

"The prize winners in the third annual Essay Contest were: Jeanette Maschmann, for her paper "Carl Frederick Gauss, His Life and Work"; Sister Ermelinda Von Domelen, of the Sisters of St. Mary, for the paper "Gauss' fundamental theorem of algebra."

—Missouri Gamma Chapter.

"Our chapter gives two awards each year. One award goes to the freshman making the best score on an honors examination. The other award is given to the graduating senior who has the best record from the standpoint of the number of hours taken in mathematics and the quality of the work done. This second award is determined by the members of the faculty.

"At the end of the academic year 1948-1949, for making the highest grade on the freshman honors mathematics examination, James Turner, Jr., was recognized; Mrs. Christine Whitman and Marion Smith were honored jointly as outstanding seniors in mathematics."

—Louisiana Alpha Chapter.

"Other activities of the fraternity were: . . . ; the 'Problem of the Month' contest, consisting of a monthly mathematics problem with all prizes awarded to the first person giving the correct solution; and the annual calculus examination with prizes won by William Posladek, William Nichols and Aldo Linsenbardt."

—Missouri Alpha Chapter.

"Prizes consisting of mathematics books were presented to the winners of the Annual Mathematics Contest. These were: First prize, Mr. Miles Maxwell, Jr.; Second prize, Mr. Earl Scott."

—Oklahoma Alpha Chapter.

THE NEW YORK EPSILON CHAPTER, ST. LAWRENCE UNIVERSITY

Interscholastic Mathematics Contest

Our annual contest has been held since 1939 (except during the war years) for high schools in northern New York. Each school is invited to send its three best students of mathematics and an accompanying teacher.

The test takes place in the morning from 9:30 to 12:00. It consists of geometry and algebra problems (at the level of plane geometry and intermediate algebra) and various trick and thought problems. These problems are contributed by the Pi Mu Epsilon members.

After the test, which is proctored by Pi Mu Epsilon members, the participants and their teachers are taken to lunch at the dormitories. Then, in the afternoon they are shown the campus and taken to some athletic event, usually a baseball game.

The following day members of Pi Mu Epsilon meet to correct the tests. A cup is awarded the school with the highest team score. A school which wins three times gains permanent possession of the cup. Otherwise, it is returned for presentation the following year. Gold, silver, and bronze medals are awarded the students achieving first,

second, and third places in the individual scoring. Certificates are given to the members of the winning team, the three individual high scorers, and the highest scorer from each school.

In the past only the eight schools of the Northern League have participated, but this year the scope has been widened to include the eleven additional Central High Schools of St. Lawrence County.

NEW YORK ALPHA PLAN FOR SCHOLARSHIPS

The Alpha Chapter of New York at Syracuse University has started a long range plan to interest high school students in the study of mathematics. This year in cooperation with the Maxwell School of Citizenship the following plan is being used. In March 700 high school students throughout the state, not including New York City, were selected by their fellow students to participate in a contest. Each student chosen was given a series of tests at his high school including a test, prepared by Pi Mu Epsilon, on deductive reasoning applicable to the study of mathematics as well as citizenship. On Saturday, April 29, which has been designated as Citizenship Day, the contesting students will visit Syracuse University, where they will be entertained at the fraternity and sorority houses and at the living centers.

There will be a special lecturer when the 700 contestants assemble for a joint meeting, after which the participants will form into small discussion groups, with opportunities for individual participation. During the final evening session eight University scholarships will be awarded, four full scholarships and the remaining four part scholarships. In addition, Pi Mu Epsilon will award prizes to the eight students ranking highest in the deductive reasoning test.

The committee chosen to represent Pi Mu Epsilon consists of Professor Myron Rosskopf, dual professor of mathematics and education, and Robert Cooper, treasurer of the Fraternity.

As faculty advisor of the chapter, I express the hope of the chapter that this year's plan may so attract promising students of New York State to the study of mathematics that our chapter will feel warranted in joining annually with the Maxwell School of Citizenship in a like project.

(signed)
Howard C. Bennett
Faculty Advisor

NEWS AND NOTICES

In a letter addressed to all the chapters of Pi Mu Epsilon, of date February 23, 1950, Secretary-Treasurer-General E. H. C. Hildebrandt says:

"I am also pleased to announce that the petitions to establish chapters at the University of Wichita and the University of Denver were approved unanimously by forty-two chapters of the Fraternity. The new chapters will be installed by Director-General C. C. MacDuffee sometime in April."

We are happy to announce that in the next issue of the Journal there will appear a resumé of the much talked of pamphlet entitled "Why Study Mathematics?" which was prepared by a committee appointed by the Canadian Mathematical Congress. Among other topics the pamphlet treats of careers in mathematics — a topic which we believe will prove to be of great interest to our members.

This second issue of the PI MU EPSILON JOURNAL is being forwarded to each chapter for free distribution among its active members including initiates of the current academic year. Through the generosity of the General Officers of the Fraternity the first two issues were made possible.

Proposals now being considered by the chapters include one for an additional seventy-five-cent fee to be paid to the Treasurer-General for each initiate. It is intended that the payment of this fee will entitle each initiate to two free copies of the Journal. The determination of a future policy for subscription rates to other active members is under consideration. When this policy is determined, the information will be passed on immediately to the chapters.

Meanwhile subscription rates are as follows:

For members of Pi Mu Epsilon, $1.50 for two years (4 copies). For non-members (including libraries and schools), $2.00 for two years (4 copies).

Back numbers are and will be available at 40 cents per copy for members and 50 cents per copy for non-members.

INITIATES, ACADEMIC YEAR 1949-1950

ALABAMA ALPHA - University of Alabama

William O. Armstrong
Billie B. Bryant
Jack G. Cladwell
Herbert H. Diekhans
Wallace G. Driggers
George S. Eastwood III
Jere D. Guin
L. B. Gunnells, Jr.
Joseph E. Handwerger
Franklin P. Harris
Judson J. Hart
E. Paul Hjorth
Virginia Holley
L. M. Hollingsworth
Charles Killian
Oliver L. Lacey
Joe E. Ledbetter
George V. LeGardeur
A. Edward Lilley
Joe E. Maner
Robert E. McRae
Evelyn Mathews
Roy B. Moffitt
Jack D. Munn
Ronald E. Sellars, Jr.
F. Louise Snowden
Dale Paige Solomon
William C. Stapleton, Jr.
Franz Russell Steinbacher
Sam R. Stephenson
Robert W. Vann
Eugene J. Walsh
James W. Webb
David G. Whitney
Walter L. Wilson, Jr.

CALIFORNIA ALPHA - University of California at Los Angeles

Rhoda Cagan
Thomas M. Dant
Harry Friedman
Milton J. Galper
James R. Jackson
Edward G. Law
G. Eric McAllister
Davis A. Pope
Peter Swerling
G. Milton Wing
Philip G. Hodge

COLORADO ALPHA - University of Colorado

Stephen H. Achtenhagen
Raymond Kenneth Adams
Robert C. Braddock
Earl L. Chandler
David Marion Chase
Robert A. Christopher
Albert Farnham Clark
William H. Cooper
Dick Harrison
Carolyn Morton Howe
Mike Kelton (Kudreiko)
William F. Muldrow
William Henry Neuschaefer
Lydick T. Ostwald
David M. Raduziner
Leonard Morgan Smith

Edward Joseph Corcoran
Donald C. Hagerman
Dallas Marechal Hampton
Betty Jean Thomas
Edward Dayre Thomas
H. Virginia Van Scoy
Frederick Eugene Wawrose

DELAWARE ALPHA - University of Delaware

David H. Archer
David T. Bunin
Martin G. Chasnov
Donald B. Clark
Manfred F. Goldwein
Mayo Greenberg
George H. Jonas
John F. Ries
Mervine Rosen

ILLINOIS BETA - Northwestern University

James Aagaard
Stacy Angle
John Bachar
Barry Blacklidge
Allen Breed
Albert Christensen
Jack Close
Arthur Dahl
Robert Dikkers
Herb Fox
Donald Gage
Games Gibbons
Howard Glenn
Dick Goldberg
Jerry Greuel
John Greve
John Haase
Lars Hellberg
Robert S. Johnson
Gordon Kingsley
Richard Koepcke
Donald Macintosh
James MacLean
Donald McLean
Ken Merckx
William Miller
Samuel Obety
Robert Pasek
Robert Perry
Franklin Peterson
Ken Rogers
Roger Schmalfuss
Edwin Schmall
Richard Sielaff
Thomas Simmons
Thomas Sloan
Robert Smith
Grant Steffen
Charles Stevens
Edwin Swick
Sherman Weissman
Stuart Wemple
Donald Zale

KANSAS ALPHA - University of Kansas

James Earl Barney
Russell N. Bradt
Richard Capps
Dr. S. Chowla
Jean F. Delord
Mr. and Mrs. Max Dresden
Kuo-Chih Hsu
Harry W. Johnson
Elsie Lemon
Kenneth Lucas
Ralph M. Moon
John W. Nipps

John W. Forman
Manus Reed Foster
George Warren Griffing
Claire L. Grothusen
John McInnes Shirley
Ralph Oliver Simmons
David S. Simpson
Vidar M. Wolontis

KANSAS BETA - Kansas State College

F. A. Aschenbrennes
A. J. Carlson
Dianne Marie Davis
E. G. Hickert
E. B. Hunt
M. R. Lee
C. S. Manson
J. D. Neff
H. L. Pan

KENTUCKY ALPHA - University of Kentucky

William V. Baxter
Jim Cherry
Cecil Craig
Russel D. Dean
Carl Faith
Homer H. Given, Jr.
A. W. Goodman
Gene Hagan
Paul Sears
Sherman Vanaman

MICHIGAN ALPHA - Michigan State College

Jan-Erik Aarberg
Lowell Ray Avery
Jack Milton Baldwin
Keith M. Baldwin
James M. Barnes
Paul Buben
Charles Arthur Cassell
Mark Histrand Doty
Sam A. Fittante
Rebecca Jane Fraser
Lucy Peng-Fei Fu
Warren Edward Grabau
John A. Grosskopf
Tom Fuller Harcourt
Kenneth Melvin Johnson
Richard H. Kropschot
Martha Jean Kunkel
Frederick W. Lampe
John J. LaRue
Gerald Hugh Lewis
Richard T. Masters
James H. Matheny
Robert C. McBryde
Ellen F. Monkus
George Edward Monroe
Irving Stanley Katz
Herbert Abner Moses
Margaret Yuriko Oda
William John Ruby
James D. Skandalaris
George Henry State

MISSOURI GAMMA - St. Louis University

John J. Antal
William A. Barker
Harry W. Bartz
David D. Beyer
Elizabeth Ann Hrametz
Elbert C. Hubbard
Richard Norbert Kern
Walter M. Knopik

Catherine Joan Boone
Edward M. Brooks
Joseph E. Brown, S.J.
Catherine Cannariato
Murray Cantwell
Robert Erwin Claude
James A. Cline
Melvin E. Clover
John L. Collins
Sr. Mercedes Coughlin, O.S.U.
James C. Cunningham
Bro. Edward Doody, F.S.C.
Sidney I. Duddy
Fred J. Dulle
Joe G. Eisley
Shirley M. Elsey
Morrison C. England
Eugene Eschbacher
Charles P. Farley, Jr.
Margaret Reh Farley
Charles P. Felix
Sr. Helen Marie Finn, R.S.M.
Rev. John E. Fischer, S.J.
Albert L. Forst
Lawrence W. Friedrich, S.J.
Bro. Gerard Gardner, F.S.C.
Ramon A. Garrett
Alfred S. Gaskin
Richard E. Gauvin
Rev. Francis A. Gaydos
Edward J. Grill
Stephen L. Gugleta
Carlos C. Guzman
James W. Hart
James E. Haubert
Roland F. Herbst
J. R. Hilbert, S.J.
George J. Holland
Charles E. Holmes
Robert K. Horak
Norbert C. Koetting
Eugene J. Kovarik
Gene H. Kuhn
Paolo Lanzano
Fred Leo Linkul
Robert Lommen
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Terence O. McVay
Owen G. Masterson
William M. Menco
William T. Miller, S.J.
James E. Monahan
Leo J. Mueller
Rev. Jerome J. Murray, S.J.
Evelyn Murrill
Herbert H. Nuttli
John M. Patterson
Sr. M. Magdala Pieschel, C.S.J.
Frank F. Pilotte
Arthur W. Poehlman
Bernard W. Quinn
Virgil R. Rehg
Alan Rundle
Michael Ryan
Robert Otto Schepman
James E. Schmidt
John Joseph Schoen
Patrick Joseph Sharpe
Douglas V. Signaigo
John Sinnott
Peter B. Smith
Edward F. Sturcken
Richard Toenishoetter
Theresa Trenshaw
Joseph B. Vacca
Leonard Walts
Leo F. Weber, S.J.
W. Garrett Wheeler
Glenn F. Williams, S.J.
James C. Wroble

MONTANA ALPHA - Montana State University

Harold Bennett
Marybelle Frye
Alfred J. Murray
Jean Popham

Diana Grabow
William Jameson
Frank McCay
Amy Muneta
Evan Rempel
Merton Robertson
Elsie Taylor
Eva Thorne
Richard B. Wood

NEBRASKA ALPHA - University of Nebraska

Philip Nye Armstrong
Gordon Eugene Bale
N. G. Barker
William Russell Blank
Anthony Louis Bueltel
Berwyn B. Caswell
George B. Cobel
Charles J. Cook
Donald Eugene Dan
James Andrew Dulton
Walter George Elwell
Adrian Earl Glandon
Richard G. Hanisch
Dale Roland Ingwerson
Edwin T. Jipp
John C. Johnson
Marvin L. Keedy
William D. Kerr
E. Eugene Kirsch
Edward Charles LeBeau
Robert J. Mason
Forrest S. Mozer
Donald Wayne Proctor
James W. Reinders
R. R. Robinson
Edward T. Saad
Richard Rollin Short
Robert R. Smith
Edward G. Swenson
Donald R. Weyenberg
Richard Albert Dudek

NEW HAMPSHIRE ALPHA - University of New Hampshire

Dennis B. Ames
Philip Bartlett
Joseph Bonk
Dorothy Breyneart
John S. Brodhowiz
Dorothy Burnett
George A. Gallant
Charles Gerrish
Roy Hill
Robert Kimball
James Konides
Joseph Lambert
Maurice D. Meader
Swen Peterson
Frederick Russell
Cornelius Schenck
Charles Sewell
Evelyn Snow

NEW YORK ALPHA - Syracuse University

Norman W. Alperin
Irving Ames
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